CHAPTER 7
IMPLEMENTATION AND ASSESSMENT OF ISAT903

7.1 Implementation Approaches, Tools And Techniques

A study on the various types of approaches, tools and techniques which can be employed during the implementation stage is made prior to the actual implementation of ISAT903.

The approaches which can be appropriately used for the construction of ISAT903 consist of combination of structured and object-oriented programming.

Each module performs independent function, therefore it can be developed in any order. However, a version number is used to aid in the process of module development. The version number is updated when other modules are being developed and combined with the old version. Basically the primary functions performed by ISAT903 are developed first. Such as, the version numbers for development process of ISAT 903 are designed as shown in Table 7.1.

Table 7.1 The Version Number For Development Process of ISAT903

<table>
<thead>
<tr>
<th>Version Number</th>
<th>Modules Developed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Version 1.0</td>
<td>Main Menu</td>
</tr>
<tr>
<td></td>
<td>Assessment Section</td>
</tr>
<tr>
<td></td>
<td>1. Framework</td>
</tr>
<tr>
<td></td>
<td>1.1 Management Responsibility</td>
</tr>
<tr>
<td></td>
<td>1.2 Quality System</td>
</tr>
<tr>
<td></td>
<td>1.3 Internal Quality System Audit</td>
</tr>
<tr>
<td></td>
<td>1.4 Corrective Action</td>
</tr>
<tr>
<td></td>
<td>2. Life Cycle</td>
</tr>
<tr>
<td></td>
<td>2.1 Contract Review</td>
</tr>
</tbody>
</table>
### Table 7.1 (Continued)

| 2.2 Purchaser's Requirement Specification |
| 2.3 Development Planning |
| 2.4 Quality Planning |
| 2.5 Design and Implementation |
| 2.6 Testing and Validation |
| 2.7 Acceptance |
| 2.8 Replication, Delivery and Installation |
| 2.9 Maintenance |

3. Supporting

| 3.1 Configuration Management |
| 3.2 Document Control |
| 3.3 Quality Record |
| 3.4 Measurement |
| 3.5 Rules, Practices and Convention |
| 3.6 Tools and Techniques |
| 3.7 Purchasing |
| 3.8 Included Software Product |
| 3.9 Training |

<table>
<thead>
<tr>
<th>Version 1.1</th>
<th>Report Section</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Management Summary Report</td>
</tr>
<tr>
<td></td>
<td>2. Management Compliance Report</td>
</tr>
<tr>
<td></td>
<td>3. Assessment Result Summary</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version 1.2</th>
<th>Help</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Contents</td>
</tr>
<tr>
<td></td>
<td>2. Search For Help On</td>
</tr>
<tr>
<td></td>
<td>3. About</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reference Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ISO 9000-3</td>
</tr>
<tr>
<td>2. ISO 9004-2</td>
</tr>
<tr>
<td>3. ISO 9004-4</td>
</tr>
</tbody>
</table>

The major goal of the development is to develop simple, clear and elegant program so that readability of code, ease of understanding, debugging, testing, documentation and modification of programs can be enhanced [OSi89].

The structured coding and object-oriented programming are used to achieve these important goals.
Fundamentally, the structured coding technique employed for the implementation of ISAT903 is the single entry, single exit construct for specifying the control flow in algorithms. This construct encompasses:

1. Sequencing
2. Selection (Case of -End Case)
3. Iteration (Do-While)

The algorithm for each module of ISAT903 are designed based on these single entry, single exit constructs. These algorithms are then translated into Program Design Language (PDL) or Pseudo Code [OSI89] before they are programmed by using Delphi programming language.

Besides these approaches and techniques, programming tools such as Delphi's Integrated Development Environment (IDE) are employed for the project development. IDE, is an environment that provides all the tools necessary to design, run and test an application. In Delphi 3.0, the IDE consists of a code editor, debugger, toolbar, image editor and database tools, all of which operate in an integrated fashion [DAN97]. This integration gives the developer a set of tools that operate in harmony and compliment one another. The result is faster and less of error in developing of ISAT903 application.

7.2 ISAT903 Modules

The development process of ISAT903 is based on the version numbers as defined in the previous section, starting from version 1.0. At the beginning the implementation of version 1.0 is developed. It is then followed by
implementation of version 1.1 and the last implementation of version 1.2. The coding process can thus be done separately, and test individually. After being tested for logic errors, they are then integrated and tested again.

7.2.1 Main Module

The major function performed by the Main Module is to create Main Menu and display a selection menu to enable a user to choose a particular function. The particular function selected by Mouse On Click (MOC). The algorithm and pseudo code for the Main Module are discussed below. However, the algorithm and pseudo code for modules which are simple and trivial are omitted.

The Main Module

*Algorithm:*

Create main form;

Set form properties;

Adding component to the form;

Create menu bar, namely:

- Assessment Section
- Reference Section
- Report Section
- Help
- Exit

Create pull down menu on Assessment Section, namely:

- Framework
- Life Cycle
• Supporting

Create pull down menu on Framework, namely:

• Management Responsibility
• Quality System
• Internal Quality System Audit
• Corrective Action

Create pull down menu on Life Cycle, namely:

• Contract Review
• Purchaser's Requirement Specification
• Development Planning
• Quality Planning
• Design and Implementation
• Testing and Validation
• Acceptance
• Replication, Delivery and Installation
• Maintenance

Create pull down menu on Supporting, namely:

• Configuration Management
• Document Control
• Quality Record
• Measurement
• Rules, Practices and Convention
• Tools and Techniques
• Purchasing
• Included Software Product
• Training
**Pseudo codes:**

Program ISAT903

Begin

Create main form;

Case of mouse on click (moc)

{ click mouse button on the available button as necessary }

case Assessment Section click:

   go to procedure Assessment Section;

case Reference Section click:

   go to procedure Framework Section;

case Report Section click:

   go to procedure Report Section;

case Help click:

   go to procedure Help;

case Exit:

   go to procedure Exit;

end case;

end.

7.2.2 Assessment Section Module

The following items are the assessment section module algorithm and pseudo code.

*Algorithm:*
Begin

Create form IsoSoft

Create pull down menu on Framework namely:

- Management Responsibility
- Quality System
- Internal Quality System Audit
- Corrective Action

Create pull down menu on Life Cycle, namely:

- Contract Review
- Purchaser's Requirement Specification
- Development Planning
- Quality planning
- Design and Implementation
- Testing and Validation
- Acceptance
- Replication, Delivery, and Installation
- Maintenance

Create pull down menu on Supporting, namely:

- Configuration Management
- Document Control
- Quality Record
- Measurement
- Rules, Practices, and Convention
- Tools and Techniques
- Purchasing
- Included Software and Product
- Training.

End.
Pseudo codes:

Program ISO903

Begin

Create form IsoSoft
Set form properties;
Adding components to the Form;
Set components properties;
Create data module ;
Set data module properties;
Create table;
Set table properties;
Placing code behind the components;
Show Form IsoSoft;
End.

Case of mouse on click
{ click mouse button on the available button as necessary }

Case of Framework click:

Go to procedure Framework;

Case of Management Responsibility click:

Go to procedure Responsibility;

Case of Quality System click:

Go to procedure Responsibility;

Case of Internal Quality System Audit:

Go to procedure Quality System Audit;

Case of Corrective Action :

Go to procedure Corrective Action;

End case.
Case of Life Cycle click:

Go to procedure Life Cycle;

Case of Contract Review click:

Go to procedure Contract Review;

Case of Purchaser's Requirement Specification click:

Go to procedure Purchaser's Requirement Specification;

Case of Development Planning click:

Go to procedure Development Planning;

Case of Quality Planning click:

Go to procedure Quality Planning;

Case of Design and Implementation click:

Go to procedure Design and Implementation;

Case of Testing and Validation click:

Go to procedure Testing and validation;

Case of Acceptance click:

Go to Acceptance;

Case of Replication, Delivery and Installation click:

Go to procedure Replication, Delivery, and Installation;

Case of Maintenance click:

Go to procedure Maintenance;

End case.

Case of Supporting click:

Go to procedure supporting;

Case of Configuration Management click:

Go to procedure Configuration Management;

Case of Document Control click:

Go to procedure Document Control;

Case of Quality Record click:

Go to procedure Quality Record;
Case of Measurement click:
  Go to procedure Measurement;
Case of Rules, Practices, and Convention:
  Go to procedure Rules, Practices, and Convention;
Case of Tools and Techniques click:
  Go to procedure Tools and Techniques;
Case of Purchasing click:
  Go to procedure Purchasing;
Case of Included Software Product click:
  Go to procedure Included Software Product;
Case of Training click:
  Go to procedure Training;

End case.

End.

7.2.3 Reference Section Module

The following items are the reference section module algorithm and pseudo code.

Algorithm:
begin
  Create form;
  Create pull down menu on Reference section namely:
  • ISO 9003-Reference
  • ISO 9004-2 Reference
  • ISO 9004-4 Reference
End.

Pseudo codes:

Program ISO903_REF
Begin
Create form ISO 9003-REF;
Create data module;
Create table;
Show Form ISO 9003-REF;

End.

Case of mouse on click

{ click mouse button on the available button as necessary }

Case of ISO 9000-3 click:

Go to procedure ISO 9000-3 Ref;

Case of ISO 9004-2 click:

Go to procedure ISO 9004-2 Ref;

Case of ISO 9004-2 click:

Go to procedure ISO 9004-4 Ref;

End case.

End.

7.2.4 Report Section Module

The following items are the report section module algorithm and pseudo code.

Algorithm:

Begin

Create RepForm Management Report;
Create RepForm Management Compliance Summary;
Create RepForm Assessment Summary Report;
Create data module;
Create table;
Show RepForm Management Report;
Show RepForm Management Compliance summary;
Show RepForm Assessment Summary Report;

End.
**Pseudo codes:**

Procedure RepForm;

Begin
    Create RepForm Management Report;
    Create RepForm Management Compliance Summary;
    Create RepForm Assessment Summary Report;
    Create data module ;
    Create table;
    Case of mouse on click

    { click mouse button on the available button as necessary }

    Case of Management Report  click:
        Go to procedure Management Report;
        Show RepForm Management Report;
    Case of Management Compliance summary:
        Go to procedure Compliance Summary;
        Show RepForm Management Compliance summary;
    Case of  assessment Summary Report:
        Go to procedure Assessment Summary report;
        Show RepForm Assessment Summary Report;

    End case

End.

7.2.5 Help Module

The following items are the report section module algorithm and pseudo code.

*Algorithm:*
Begin

Create Form Help;
Create data module;
Create table;
Show Help Form;

End.

_Pseudo codes:_

Begin

Create Form Help;
Create data module;
Create table;
Show Help Form;

_Case of mouse on click_

{ click mouse button on the available button as necessary }

Case of Contents click:

Go to procedure Contents;
Show Help Form;

Case of Search For Help On click

Go to procedure Search For Help On;

Case of How To Use Help click:

Go to procedure How To Use Help;

Case of About click:

Go to procedure About;
End case.

End.

7.2.6 Exit Module

The following items below are the exit section module algorithm and pseudo code.

*Algorithm:*

Begin

Procedure Exit;

End.

*Pseudo codes:*

Begin

*Case of mouse on click*

{ click mouse button on the available button as necessary }

Case of Exit click:

    Go to Procedure Exit;

End case.

End.
7.3 Approaches and Strategies of Testing Used

The various type of approaches and strategies can be used for the testing of a software system. In this project, three types of testing were employed for the testing of ISAT903. These testing are unit testing, integration testing and system testing [IAN98],[TOM93]. Unit testing is used to test the correctness of the individual modules. As such, unit testing is being performed simultaneously with the implementation of ISAT903. The integration testing is then carried out to correct and debug errors relating to the interactions of the different modules when they are integrated. Finally, a system testing which is often called the acceptance test [IAN98] is being carried out to ensure the system developed performs the design tasks properly and fulfills the functional and performance specifications specified during the requirement phase. In accordance with the proper procedure of testing, this acceptance test should be conducted by the end user rather than the system developer [IAN98].

During the implementation phase of ISAT903, unit testing has been employed for each of the smallest modules of ISAT903. It is done by giving a set of input data to the program, and the output results are examined to see that the operations performed are according to the expected results. In other words, it is a module testing to determine whether the module meets its specifications. Corresponding to this module testing, two testing strategies are employed. These testing strategies are known as the black box and white box testing [IAN98],[TOM93]. In black box testing, tests are conducted to demonstrate that
each function of ISAT903 is fully operational. In white box testing, tests are conducted to ensure that internal operation performs according to specifications. Finally, when the two modules of version 1.2 of ISAT903 have been implemented, this version number is then integrated with version 1.1. A complete test is then implemented on ISAT903 to ensure that all functions of ISAT903 are executed in the proper and correct manner, and ISAT903 can be used by designers and programmers for their designing tasks.

7.4 Performance of ISAT903

In chapter 2, the twelve (12) quality attributes have been defined as the performance specification for ISAT903. It is necessary at this stage to make a review on these twelve attributes to analyze how far they have been achieved by ISAT903. The achievement of ISAT903 respecting to these twelve performance specifications are discussed individually as follows:

Correctness

The test result was proven to be correct. ISAT903 is thus shown to have achieved the correctness performance.

Reliability

All the functions performed by ISAT903 were tested and used for self assessment for the quality system of software industry. By having the report section, ISAT903 produced the management summary reports as evaluation and quality rating of the quality system. Therefore, ISAT903 is reliable in performing and executing main function of ISAT903.
Efficiency

Generally, most of the functions performed by ISAT903 shows the efficient use of memory space and high speed of execution. ISAT903 is fully manipulated by the user through the use of a mouse instead of the keyboard. This makes ISAT903 operates efficiently.

Integrity

To ensure the integrity of ISAT903, the record are protected, so unauthorized users can't edit, delete, and add to the record.

Usability

Relative effort for training or software operation (eg. Familiarization, input preparation, execution, output interpretation), that is extented to which ISAT903 is designed user friendly so user can do self assessment, without other assistance.

Portability

Relative effort to transport the software for use in another environment (hardware configuration and / or software system environment). It is the reflection of ease with which ISAT903 can be transferred from one computer system or environment to another. Therefore standard execution file (.EXE) are used to develop ISAT903 to ensure that ISAT903 can run on another PC system which are installed with Windows 95/98 operating system. From the number of respondents who have filled and submitted the questionnaire on the customer evaluation, it is found that most of them tell that setting up is easy.
Reusability

Relative effort to convert a software component for use in another application. The concept of software reusability and component libraries have come to light in recent years. There is less chance for error, increasing in productivity and quality. Figure 7.1 demonstrates the use of reusability attribute in the ISAT903 project.

```pascal
procedure TISoft9000.N61ConfigurationManagement1Click(Sender: TObject);
begin
  DataModule2.Table4.open;
  DataModule2.Table4.First;
  DataModule2.Table4.MoveBy(65);
  ISOSoft.show;
end;

procedure TISoft9000.N62DocumentControl1Click(Sender: TObject);
begin
  DataModule2.Table4.open;
  DataModule2.Table4.First;
  DataModule2.Table4.MoveBy(72);
  ISOSoft.show;
end;

procedure TISoft9000.N63QualityRecord1Click(Sender: TObject);
begin
  DataModule2.Table4.open;
  DataModule2.Table4.First;
  DataModule2.Table4.MoveBy(75);
  ISOSoft.show;
end;

procedure TISoft9000.N64Measurement1Click(Sender: TObject);
begin
  DataModule2.Table4.open;
  DataModule2.Table4.First;
  DataModule2.Table4.MoveBy(76);
  ISOSoft.show;
end;
```

**ISOSoft is a reusability Form**

Figure 7.1. Reusability Attribute
Interoperability

We can see that ISAT903 is installed in a Windows environment and utilized many components of Windows 95.

Maintainability

The source code of ISAT903 are developed using Delphi programming language (Visual Pascal programming). These Delphi programs are developed by using structured programming techniques and developed in a general manner, so that they can be reused and shared by other programs or executed individually by the user to perform a specific task. This feature enables the other programmers to understand the program easily. Thus maintenance and modifications can be implemented on ISAT903 for the future expansion without any difficulties.

Flexibility

ISAT903 is very flexible. For example we can edit the module Help section easily by running the Help writer tool.

Testability

When a user chooses the "yes" answer and clicks the save button, the score will increase one point immediately and the quality rating remains "Poor". If we continue to fill in the question boxes with "Yes", the quality rating will change from "Poor" to "Fair" when scores is equal to 35 or 25 % of the total score. If we continue to fill in the question boxes with "Yes", the quality rating will change from "Fair" to "Good" when scores is equal to 70 or 50 % of the total score. If we
continue to fill in the question boxes with "Yes", the quality rating will change from "Good" to "Excellent" when scores is equal to 105 or 75% of the total score.

7.5 Validation of ISAT903

Validation is carried out by filling in all the answer boxes with "No" on the first/previous column of assessment and filling in all the answer boxes with "Yes" on the current/last column of assessment. Then, we see the results in the report section.

When we select and click management compliance summary menu, we see that the compliance of all ISO 9000-3 elements is "Poor" on the first/previous column and the compliance of all ISO 9000-3 elements is "Excellent" on the current/last column of assessment. This case shows that ISAT903 is valid. It is shown in Figure 7.2

When we select and click assessment result summary, we see that the quality rating is "Poor" when the total score is equal to 0 (zero) and the quality rating is "Excellent" when the total score is equal to 140. From both reports we conclude that ISAT903' validation has been proved. It is shown in Figure 7.3.
Figure 7.2 Management Compliance Summary

Figure 7.3 Assessment Summary Report
7.6 Strength of ISAT903

Generally, a set of conspicuous features and characteristics is usually inherent in a good software system. ISAT903 also possesses a number of features and characteristics which can be viewed from the aspects of interactivity, user friendly, simplicity of use and attractiveness. These attributes give the designer and programmer a useful and interesting environment to work with. Each of these attributes is described simply as follows:

Interactivity

A user is sometime required to input a simple answer such as "Yes" or "No" to the questions asked by ISAT903. The reply to these questions is validated before the user can proceed further with the designing task. This kind of simple answers will avoid the number of human errors introduced by the user when answering the questions and saves time. From a number of respondents who have filled and submitted the questionnaire on the customer evaluation, it is found that most of them tell that ISAT903 is interactive.

User-friendliness

ISAT903 is menu driven under Windows 95/98 environment. The user is only required to select one of the options from the menu. On completion of the function selected by the user, ISAT903 will return the user to the Main menu. Simple and clear guidance is also provided by Reference section and Help section. From a number of respondents who have filled and submitted the
questionnaire on the customer evaluation, it is found that most of respondents agree with ISAT903 is user friendly.

Simplicity of use

The Reference Section and Help Section are design to provide sufficient information on the assessment the user's quality system. From a number of respondents who have filled and submitted the questionnaire on the customer evaluation, it is found that most of them tell that ISAT903 in operating is ease.

Attractiveness

Each function of ISAT903 is designed with a combination of attractive colors and images. From a number of respondents who have filled and submitted the questionnaire on the customer evaluation, it is found that most of them tell that ISAT903 is attractive.

7.7 Limitations of ISAT903

Based on the guideline for the application of ISO 9001 to the development, supply and maintenance of software which are consisting of the 22 quality elements and cross section between ISO 9000-3 and ISO 9001, it is arranged to evaluate the quality level as the starting point to prepare the arrangement steps of quality system with standard on ISO 9000-3 as well as to make preparation to get certification of ISO 9001.

This tool cannot certify directly the software industry to be ISO 9001 compliant based on the result obtained. Certification is an audit process by third party with a rigorous inspection and demonstration of the process documentation and
practices. At the best, the result is used as an understanding of the general level of readiness, strength and weakness of the software industry with respect to the ISO 9000-3.

7.8 ISO 9000-3 Preparation and Implementation

When the software company decides to apply for ISO 9000-3 registration, the first thing to do is to obtain top management's support which involves the budget, time and thorough understanding of what is required for ISO certification. The next steps are as follows [ISO96]:

1. Forming ISO implementation team
2. Obtaining a copy of the ISO standards
3. Having implement a training program for ISO overview and requirements for the rest of staff in the organization
4. Training the team members on the details of standards and what needs to be accomplished. The training program should not just cover procedural and job-related issues, but also the need for change; including tools for problem solving, developing measurement criteria, and presenting data.
5. Starting the developing and documenting the quality policy, plan, and procedures. If the company already has a manual in place, review and update it so that it is current. The quality plan should support the quality policy and the procedures must cover all of the ISO elements such as document control, training, internal audits, corrective action, and quality records.
6. Training the staff on any new procedures and ensure the staff is following these new procedures.

7. Forming an internal audits team and train the members on how to conduct the audits based on ISO standards and internal documented procedures.

8. Doing Schedule audits by internal audit team members

9. Reviewing any nonconformance discovered by the audit members; address the nonconformance and if necessary update the quality manual and procedures accordingly.

10. Interviewing and selecting the external auditors for pre registration audit to identify any non conformity that may have missed the internal audit process.

11. Addressing non conformities found by external auditors.

12. Contacting, selecting, and applying to a registrar.

13. Undergo formal audit by registrar.

Prior to the audit, the registrar sends the audit plan to the organization. The plan outlines the audit schedule, agenda, and the areas to be audited. When the audit team arrives at the organization, there is an opening meeting with management during which following topics are covered:

- Introduction of team members
- Description of audit, scope, purpose, and procedures
- Review of agenda and confirmation of schedule
- Clarification of any points not understood.
After opening meeting, the audit begins. The auditors assess predetermined aspects of the operation to the standards. They look for objective evidence that the organizations conforming to its own pre established standards and that these standards meet with the intent of the ISO standards.

When the team completes the audit, they meet with the organization to review all the findings. Copies of non compliance are given to the organization and the corrective action dates are obtained by the registrar. The organization provides a documented plan on how the corrective actions will be made and implemented. Upon confirmation of implementation of this plan, if registrar satisfied, it grants registration and issues a registration document to the organization. The registration is an ongoing process in which the registrar will perform periodic surveillance audits to ensure the quality system is being maintained.